Current Status of the Florida Marine Spill Analysis System (FMSAS) Version 3

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Abstract

This paper addresses the status of the 3rd version of the FMSAS, a spatial decision support system that is designed for oil spill response. This latest version incorporates several new enhancements that were developed as a result of user feedback and from our own experience. Most of the enhancements have focused on making the system easier to use yet at the same time making it capable of handling more complicated situations. Other efforts have centered on improving the adaptability of the system so that it can be modified to satisfy user needs beyond spill response.

Introduction

FMSAS development started in early 1992. Over the next five years it evolved to take advantage of new technologies and to support increasing user needs. The original FMSAS, based on an earlier system developed by Environmental Systems Research, Inc. (ESRI) for Abu Dhabi (Sorensen, 1995), started out as an Arc/Info application running on UNIX workstations located at the Florida Marine research Institute (FMRI). This original version, though powerful, suffered from several shortcomings, the greatest of which were its lack of portability, that it only covered a small portion of the state, and that an Arc/Info expert was needed to operate it. Version 2 of the FMSAS, co-developed by ESRI and FMRI, was an ArcView 2.1a application that remedied these main problems, however, it soon became apparent that it too had several shortcomings most of which centered on the fact that ArcView 2.1a was not a true Geographic Information System (GIS) (Friel et al., 1996) and that the then current laptop PC's were not powerful enough. The third and current version of the FMSAS, also co-developed by ESRI and FMRI, is a much more user-friendly and powerful system that runs in ArcView 3.0. This latest system takes full advantage of ArcView 3.0's powerful suite of GIS tools and is installed on Pentium laptop PC's.

Embedded in all the new requirements was also the idea that the FMSAS needed to be adaptable for use by more than the spill response community. Other agencies and individuals, when shown the FMSAS, expressed that they could really benefit from it's core analytical and map making capabilities. The FMSAS started being viewed as a "springboard" system that could be used to launch numerous other environmental analysis applications.

Enhancements to FMSAS

The second version of the FMSAS operating in ArcView 2.1a was deployed on laptop PCs to all six BER regional offices from early 1996 through October 1997. During this time BER staff provided feedback to FMRI about problems they encountered and also what new software tools they would like to see added. This feedback, combined with our own experiences and comments solicited from other spill response experts, became ESRI's marching orders when development of FMSAS version 3 began. Version 3 was delivered to FMRI in August, 1997 and deployed to the BER field stations in November, 1997.

The BER feedback identified two types of deficiencies: system and software usability and hardware. The following list identifies the main problems and their solutions, however, there are many more enhancements that are not listed here.

System and Software Usability

1) Problem - The graphical user interface (GUI) was complicated. It was largely menu driven and the actual menu items were hard to understand and were not in places where the user would expect to find them.
   Solution - This was corrected by using ESRI's new dialog designer extension which provides Visual Basic-like tools for GUI development. This allowed for the creation of dialogue boxes and buttons which are more intuitive and simple to use. The software tools were more logically grouped and menus were simplified using plain English.

2) Problem - The original Resources at Risk (RAR) tool was designed to identify which natural and human resources were present in an area impacted by an oil spill. Although useful it had limitations. First, it suffered from not having traditional GIS "clipping" functions. This meant that the user could only get approximate area calculations instead of true area calculations. Second, it did not differentiate among impacted resources that fell within a managed area and those that did not. This is important in Florida where damage assessments vary according to whether damage occurs in a managed area such as an aquatic preserve, or not. Third, the user was limited to a fixed number of databases that could be analyzed; new databases could not be added to the RAR list. Fourth, the RAR output could not be loaded into industry standard spreadsheets such as Excel and Quattro Pro.
   Solution - The first two problems were addressed when the FMSAS was migrated from ArcView 2.1a to ArcView 3.0. The new ArcView was designed to perform true "clips". The third was corrected by writing additional code to allow both the importing of new GIS databases and also direct user input. The fourth was addressed by having the RAR report delivered as a comma separated ASCII file which is importable by most spreadsheets.

3) Problem - In version 2 the data and their graphic representation had taken a "back

seat" to software migration. The cartographic display was poor, legend names were cryptic, and some important databases were still in a developmental stage. Solution - This was addressed in a multifaceted manner by first accelerating the QA/QC process for the databases in question, second the legend files were rebuilt to work better in the "screen" environment, third all the legend names were changed to be more intuitive.

4) Problem - Version 2 was unable to analyze MMS's new Gulf-Wide Information Systems (G-WIS) Environmental Sensitivity Index (ESI) data structure (CCEER, 1996). The FMSAS had been hard-wired to analyze only the existing ESI data (RPI, 1995) . This meant that the additional data found in G-WIS ESI could not be accessed and analyzed.
Solution - A tool was developed by ESRI to handle both traditional and G-WIS ESI. The user simply specifies which ESI database to analyze.

5) Problem - There was no simple way to find locations by name. The user had to know where the place actually was and then move there. If the user was not familiar with the location of a place the system did not provide an easy way to find it. Furthermore, marine spills are often positionally described as being a specified distance and bearing from a named place or feature such as an aid to navigation. The system was not capable of handling positions defined by distance and bearing.
Solution - A simple dialog box was designed that allows the user to enter the name of a place, such as a town, or a latitude/longitude coordinate and with a press of a button can have that place centered right on their screen. This same dialog box also allows the user to enter a true bearing and distance from a location and then go there automatically. Additional entries let the user define how much of the area around the selected place they wish to have also displayed on the screen.

6) Problem - Limitations existed with the tools that managed the progression of a spill. It was confusing to use and did not easily keep track of several spills going on at the same time such as occurred during the 1993 Tampa Bay spill (Friel et al., 1993). Furthermore, there was no way to "buffer" or increase the perimeter of a spill boundary by a specified distance. This is extremely important for planning purposes where a frequent requirement in "what if" scenarios is the ability to show a spill boundary surrounded by increasingly larger concentric, spill boundaries.
Solution - This has been handled well in the new Spill Event Manager. Spills are easily added, either by entering them directly on-screen using the cursor, from existing GIS files, or from latitude/longitude coordinates. Multiple spill boundaries are kept linked to their spill source and maintained separately from other boundaries and sources in an easily understood and well organized display. FMSAS Version 3 takes advantage of ArcView 3.0's buffering ability to allow both boundaries and spill source points to be buffered.

7) Problem - There was no ability to track the deployment of booms.

Solution - The Spill Event Manager has an option that allows the user to add the locations of booms and keep track of them over time. The characteristics of the boom, such as type, length and can be entered into a database.

8) Problem - Linking many media objects such as digital photos, movies, and audio files, to map features was very cumbersome. Users wanted this ability but were frustrated by the work involved.
Solution - ESRI programmers enhanced the "hot link" tool interface so that a "wizard"-like dialog box walks the user through the linking process. The user can now link an unlimited number files to any map feature or graphical feature. These are all organized in a menu and can be accessed with the push of a button.

9) Problem - Unable to import NOAA HAZMAT's Oil Spill Simulation Model (OSSM) output (Galt et al., 1996). The earlier FMSAS was incapable of loading these files which are of great importance for spill response planning because they communicate possible short term spill movement. They also provide responders with textual and graphical information regarding the reliability of the information.
Solution - A tool was added that imports the OSSM trajectory information for display and analysis.

10) Problem - Overly complicated and poor map making capabilities. Hard-copy maps are in great demand during spills as was discovered during the Tampa Bay spill when several hundred maps were printed by FMRI. The early version of the FMSAS had a menu driven map making tool that was unintuitive and hard to use.
Solution - A simple button was added to the main view that would allow the user to make various sized maps of what was displayed on the screen without having to go into a separate "map composer" module. A legend, scalebar, inset map and north arrow are all automatically added and all the user has to do is enter a title and hit the print button. The existing menu based mapping tool still exists should the user decide to make a more customized map, however, it too has been significantly redesigned for ease of use.

11) Problem - Metadata were not easily accessible. The user could not quickly find the information describing the data layers.
Solution - A button was added to the GUI that allows the user to access any metadata file. All the user has to do is highlight the data layer in the data menu to the left of the map and then push the metadata button. The appropriate metadata text file is immediately displayed.

12) Problem - There was no way to efficiently handle large files of scanned imagery such as USGS quads, NOAA nautical charts or digital orthophoto quads. These had been identified by users as being extremely useful as base maps.
Solution - ArcView 3.0 was upgraded to handle ARC/INFO image catalogs. FMSAS Version 3 takes advantage of this upgrade and now allows users to access multiple scanned images as a single data layer. In addition, the image catalog

will only draw the images required by the visual extent of your "view", which greatly speeds up drawing time.

13) Problem - No User Guide. The user was dependent on the ArcView manual and any notes they had taken during their training. Also the on-line help only explained the core ArcView tools but not the FMSAS specific tools. This resulted in FMRI performing time consuming "help desk" functions.

Solution - A user manual was written for the FMSAS specifically targeted to users who had minimal exposure to computers and GIS. Plain English was used throughout and computer and GIS jargon were kept to an absolute minimum. Every single tool has been explained in an easily understood manner with numerous screen shots to help the user understand. The manual is also stored on FMRI's Internet home page as an Adobe Acrobat PDF file. So a manual can be easily replaced if it is lost.

Hardware

Problem - Hardware limitations centered on speed and storage capabilities. When the first ArcView FMSAS was delivered the fastest chip available for laptop PCs was the 486, the most RAM available was 32 megabytes and storage was less than one gigabyte meaning that additional data had to be accessed from an external CD-ROM. The FMSAS would run under these constraints, however, performance was diminished quite considerably.

Solution - Industry standards have progressed so that current motherboards can be configured with more RAM and larger hard drives, Pentium chips are the new standard and internal CD-ROM's are now efficient in size, speed and cost. The new laptop PCs are equipped with Pentium II chips, have 128 megabytes of RAM and over 2 gigabytes of storage.

Conclusion

This paper highlights several operational enhancements to the FMSAS, with a particular emphasis on hardware and software. These advancements have been implemented in strong partnership with several agencies and organizations. Input, solicited from various experts within the U.S. Coast Guard, Minerals Management Service (and associated G-WIS participants), National Oceanic and Atmospheric Administration, and Florida Department of Environmental Protection has influenced FMSAS development for maximum utility and impact. FMSAS development has benefited from a truly unique web of mutually-beneficial relationships that leverage the strengths and resources of each partner. Continual strengthening of this web, while maintaining a bias towards action will ensure future protection of coastal resources using advanced information management technologies.

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